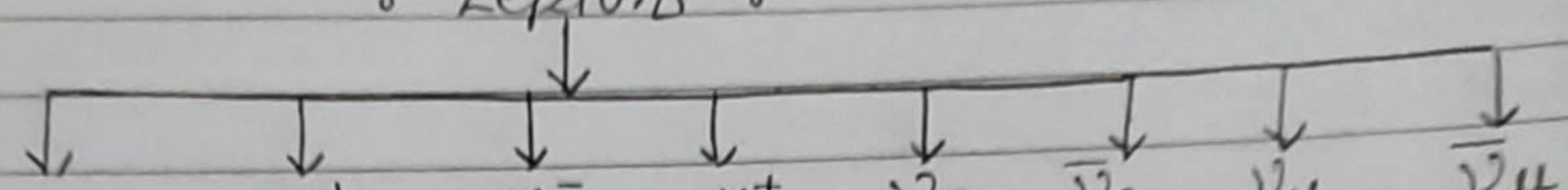
Properties of Leptons :

: Leptons :



e^- and e^+ :

e^- :- by 1987, J.J. Thomson
- Mass - 9.1×10^{-31} kg $= 0.548 \times 10^{-3}$ amu
- charge = -1.6×10^{-19} C
- spin = 1/2
- Mag. Moment = 0.93×10^{-23} Am^2
= 1.001 μ_B
- Mean life = stable.

e^+ :- by help of cosmic radiation by anderson in 1932.
- charge = same = $+1.6 \times 10^{-19}$ C
- Mass = 9.1×10^{-31} kg $= 0.548 \times 10^{-3}$ amu.
- by interaction with matter, it will generates ionization.

ii) μ^+, μ^- :

- by Anderson in 1937 and S.H. Neddermeyer.
- In 1947 → π meson also called Yukawa's particle.

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- decay production ① π-mesons

$$\pi^+ \longrightarrow \mu^+ + \nu_\mu$$
$$\pi^- \longrightarrow \pi^- + \bar{\nu}_\mu$$

② Muons decays :

$$\Sigma^\pm \longrightarrow \mu^\pm + \nu + n$$
$$\Lambda \longrightarrow \mu^- + \nu + p$$
$$K \longrightarrow \mu + \nu$$

- Mass : 206.84 m_e
- Magnetic moment = 1.0026 eh/2m
- charge = $\pm 1 e/e^-$
- Mean-life = 2.22×10^{-6} sec
- spin = 1/2
- Decay Mode = i $\mu^+ \longrightarrow e^\pm$
- Both → +V, -Ve
- Int. with matter generates ionization.
- Nuclear interactions : very weak.

i> Nutrinos (ν_e , $\bar{\nu}_e$) :

- Mass = $< 5 \times 10^{-4}$ m_e
- Mag. Moment = 0
- charge = 0
- Mean-life = stable
- Int. with matter with reactions :

$$n \longrightarrow p + e^- + \bar{\nu}_e$$
$$\bar{\nu}_e + p \longrightarrow n + e^+$$

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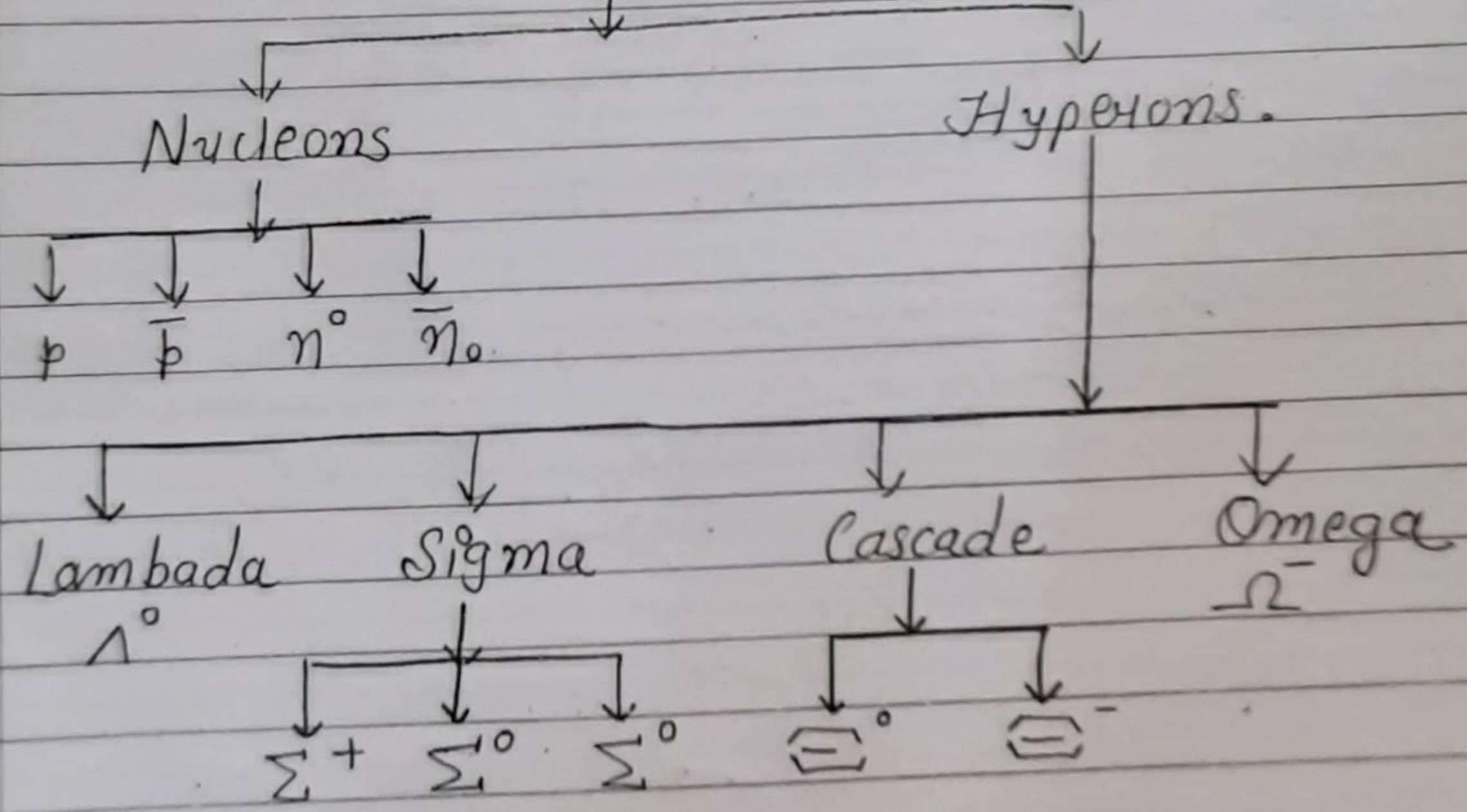
Nutrino Muons : (ν_μ , $\bar{\nu}_\mu$) :

- not associated with β- decay
- generates some reactions with π- mesons:

$\pi^- \longrightarrow e^- + \bar{\nu}_e + \nu_\mu$.
$\bar{\mu} \longrightarrow e^- + \bar{\nu}_e + \nu_\mu$ ← without radiation.
$\bar{\mu} \longrightarrow e^- + \bar{\nu}_e + \nu_\mu + \gamma$ ← with radiation

Properties of Baryons :

: Baryons :



⟹ Now properties of nucleons & Hyperons are :

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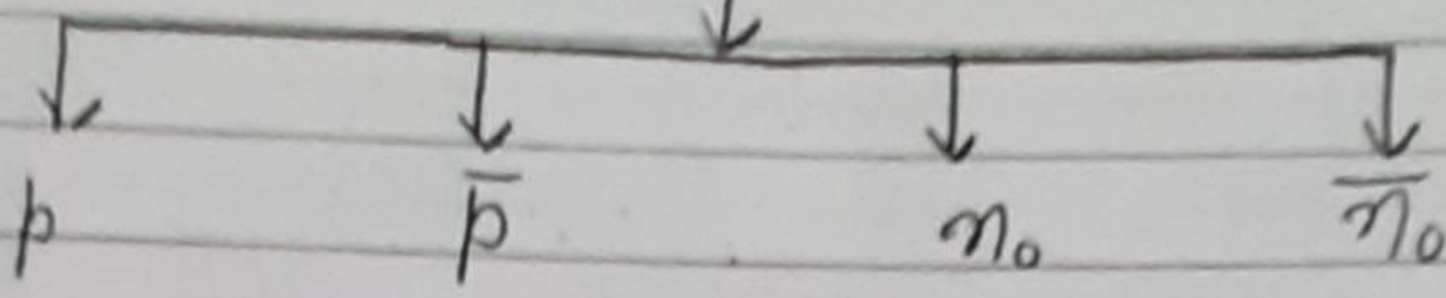
(1)

: Nucleons :



i) Protons (p) :

- Mass : 1.67×10^{-27} kg = 1.007 amu
  = 938.21 MeV
- Charge : 1.6×10^{-19} C
- Spin : 1/2
- Mag. Moment : 2.79 μ_N
- Isospin : 1/2 ; 2 ; 1/2
- I_3 : +1/2
- Mean-life : stable.

ii) Neutrons (n) :

Mass : 939.5 MeV = 1.008 amu
charge : 0 neutral.
Spin : 1/2
Mag. Moment : 1.91 μ_N
Isospin : 1/2
I_3 : -1/2
Mean-life : 1.11×10^3 sec
decay Mode : $n \rightarrow p + e^- + \bar{\nu} + 0.78$ MeV.

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iv) Anti-protons ($\bar{p}$) :

- In 1955 Using Bevatron accelarator.
- Mass : (1824 ± 55) me
- reaction : $p + p \rightarrow p + p + (p + p)$
- If nuclear mass = m_0, strikes against the stationary nucleons of same rest mass. then total energy is :

$$E = \frac{m_0 c^2}{\sqrt{1 - (v^2/c^2)}}$$

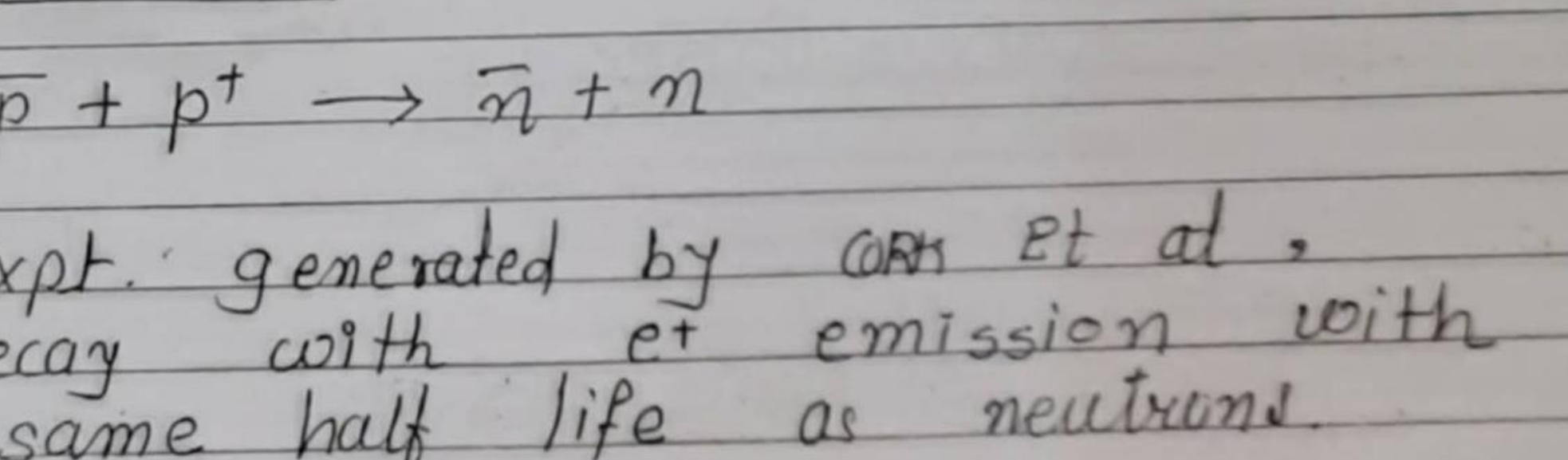
- Under CM system,

$$E = 6.566 \text{ BeV}.$$

v) Anti-nutrons ($\bar{n}$) :

- $\bar{p} + p^+ \rightarrow \bar{n} + n$
- Expt. generated by CORK Et al,
- decay with e^+ emission with same half life as neutrons.

2. Hyperons :



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i) Λ° :

- Mass : 115.36 ± 0.14 MeV = 2327 me
- Spin : 1/2
- decay mode :

$\Lambda^\circ \rightarrow p + \pi^-$ (67 %) $\rightarrow$ 37.59 MeV
$\rightarrow n + \pi^\circ$ (33 %) $\rightarrow$ 40.88 MeV

- life time : 2.8×10^{-10} sec

iiA) Σ^+ :

- Mass : (11.894 ± 20) MeV = 2181.4 me
- Reactions :

$\Sigma^+ \longrightarrow p + \pi^\circ$ (55 %) $\rightarrow$ 115.8 MeV
$\longrightarrow n + \pi^\circ$ (45 %) $\rightarrow$ 110.3 MeV

life time : 0.81×10^{-10} sec

iiB) Σ° :

- Mass : 1191.5 ± 0.5 MeV = 2331 me
- spin = 1/2
- reactions :

$\Sigma^\circ \longrightarrow \Lambda^\circ + \gamma$ = 100 % (74 MeV)

- Mean life : $< 10^{-11}$ sec.

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Σ^- :

- Mass : 1195.26 ± 0.3 MeV $= 2343.2$ me
- spin : 1/2
- Reaction :

$\Sigma^- \rightarrow n^+ + \pi^-$ (100 %) $\Rightarrow$ (11.7 MeV)

- Mean-life : $(1.81 \pm 0.1) \times 10^{-10}$ sec.

Ξ^0 :

- Mass : 1311.0 ± 8 MeV $= 2577$ me
- spin : 1/2
- Reaction :

$\Xi^0 \rightarrow \Lambda^0 + \pi^0$ (100 %)

- energy : 61 MeV
- life time : 10^{-10} sec.

Ξ^- :

Mass : 1318.4 ± 1.2 MeV $= 2580$ me

Spin : 1/2

Reaction : $\Xi^- \rightarrow \Lambda^0 + \pi^-$ (100 %)

Energy : 64 MeV

Time : 1.28×10^{-10} sec.

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iv> Ω^- :

- Mass : 1676 MeV.
- Spin : 1/2
- Reaction :

$\Omega^- \longrightarrow \Xi^0 + \pi^-$ (332 MeV)

$\longrightarrow \Xi^- + \pi^0$ (230 MeV)

$\longrightarrow \Lambda^0 + K^-$ (77 MeV)

- life time : 10^{-10} sec.

⇒ All these Hyperons have :

-Ve strangeness .

where,

$\Sigma \longrightarrow S = -1$

$\Xi \longrightarrow S = -2$

$\Omega \longrightarrow S = -3$

Anti particles of all above the Hyperons has

+Ve strangness.

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